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(54) Ceramic fibre blanket

(57) A process for producing a ceramic fiber blanket is disclosed. The process comprises the steps of preparing a laminar pile of ceramic fibers that comprise 35 to 65% by weight of alumina, 35 to 65% by weight of silica, less than 10% by weight of another metal oxide and a lubricant, superimposing a web of organic fibers on one or both sides of the pile, punching the resulting assembly with barbed needles, and removing the lubricant. The ceramic fiber blanket has a uniform thickness and a tensile strength high enough to withstand rough handling.

SPECIFICATION

Process for producing a ceramic fiber blanket

FIELD OF THE INVENTION

The present invention relates to a process for producing a ceramic fiber blanket, and more particularly to a simple process for making a ceramic fiber blanket has adequate strength.

BACKGROUND OF THE INVENTION

A process for producing a ceramic fiber blanket comprising alumina and silica is disclosed in Japanese Patent Publication No. 153/65. In this process, a fine falling stream of molten kaoli or like material is converted into staple fibers by blowing, spinning or other suitable method, th filaments are blended with a lubricant, and a web of the blend is placed on a belt conveyor an pressed between wire screens as it is heated to evaporate the lubricant. In a web of fibers that has been simply compressed without blending the fibers with a lubricant, the individual fibers are not interlinked with each other and disintegrate easily, so the web provides only a laminar structure of a very low strength that is difficult to handle. But if a web of fibres treated with a lubricant is compressed as it is heated to remove the lubricant, the fibers remain interlinked wi each other after the compression and provide a laminar structure that has strength high enoug to withstand subsequent handling.

When a ceramic fiber blanket not more than about 5 mm thick is produced by this conventional method, a meshed or roller conveyor is used to facilitate the evaporation of the lubricant during compression, and as a result, in case of the meshed conveyor a replica of the mesh pattern is left on both surfaces of the blanket and the recessed part is so thin that it can be seen through, while in case of the roller conveyor there provides an error in the dimension the blanket, as the process is carried out in the heated condition. To eliminate this problem an provide a uniformly thin blanket, fibers sufficiently short to be uniformly dispersed in water are dispersed in water in the presence of a binder and a sheet of ceramic fiber is produced by the conventional paper-making method. This wet process however needs much more labor and ha low fibre utility due to loss of fibre dust that accompanies the fibre cutting step.

SUMMARY OF THE INVENTION

Therefore, the primary object of the present invention is to provide a simple process for making a ceramic fibre blanket which has adequate strength.

To attain this object, in the present invention, firsb a laminar pile of ceramic fibers is made that comprise 35 to 65 wt% of alumina, 35 to 65 wt% of silica, less than 10 wt% of another metal oxide and a lubricant. Then, a web of organic fibers is superimposed on one or both side of the pile, the resulting assembly is punched with barbed needles, and then the lubricant is removed.

DETAILED DESCRIPTION OF THE INVENTION

Japanese Patent Publication No. 43946/77 describes a process for making a ceramic fiber blanket wherein a laminar pile of ceraminc fibers treated with a lubricant is punched with barbed needles and then the lubricant is removed under pressure. This process provides a product having a greater tensile strength than the blanket made by removing the lubricant under pressure without needle punching. But even this method does not provide a uniformly thin blanket since the meshed or roller conveyor as above mentioned is used as means to compress the pile during elimination of the lubricant. Furthermore, if more than 40 needles are punched through an area of one square centimeter in an attempt to provide a greater tensile strength, th pile is stretched in four directions and ruptures. A thin pile has inherently smaller tensile strength than a thick one and increasing the punching density to provide the thin pile with the same tensile strength as that of the thick one only results in a ruptured blanket.

Japanese Patent Application (OPI) No. 77665/75 (the symbol OPI here used means an unexamined published Japanese patent application) describes a method of punching barbed needles through a mat of inorganic nonwoven fibers that is free from a lubricant and and on which a web of organic nonwoven fibers is superimposed. In this method the mat of nonwover inorganic fibers is sewn with organic fibers, and as mentioned on page 5, upper right column, lines 14–18 of the published specification, the mat of the inorganic fibers will return to its initi bulk density by itself after the organic fibers are eleminated. Therefore, the cited part of OPI N 77665/75 shows that this method does not cause the inorganic fibers to be interlinked with each other.

It has now been that if a web of organic fibers is superimposed on one or both surfaces of a laminar pile of ceramic fibers containing a lubricant, more needles can be punched through a unit area of the pile than in the method of Japanese Patent Publication No. 43946/77 withou rupturing the pile. It has also been found that if the lubricant is removed from the punched pile

without application of pressure and if the web of organic fibers is subsequently removed, a blanket or felt that retains the interlinks between the individual ceramic fibers provided by the needle punching is produced.

If only a laminar pile of ceramic fibers containing a lubricant is punched with more than 40 needles per square centimeter, the pile ruptures, but according to the process of the present invention, no such rupture occurs even if the punching density is more than 40 needles/cm^2. This is probably because the organic fibers drawn into the pile of ceramic fibers with the needles absorb the impact of the needles and prevent the ceramic fibers from breaking apart.

According to the present invention, if a lubricant is removed from the laminar pile of punched ceramic fibers in the absence of pressure and if the web of organic fibers is then removed by incineration, the bulk density of the pile will not return to the initial value before the punching and has a great tensile strength. This is probably because the lubricant is removed from the laminar pile of ceramic fibers that are sewn tightly with the organic fibers and pressure is not particularly needed to retain the punching effect given the ceramic fibers.

Fats and oils are generally used as the lubricant in the present invention. They are evaporated from the pile of ceramic fibers by heating before the organic fibers are incinerated, and throughout the evaporation of the lubricant, the organic fibers retain their effect to clamp the ceramic fibers.

The web of organic fibers is generally made by a carding staple fibers of a fineness of usually 1.5 to 5 deniers which are 30 to 100 mm long, and the web can have a density of 30 g/m^2 or more. The carded web can be immediately used in the present invention, but more preferably, for assuring easy handling, the web is punched by barbed needles, and a web having a density of 30 g/m^2 can be used with satisfactory results. According to the process of the present invention, a ceramic fiber blanket having a satisfactory tensile strength and a uniform thickness of 5 mm or less can be produced by punching the above characterized pile of ceramic fibers with 50 to 200 needles per square centimeter that could not be used in the conventional technique without rupturing the pile. Needless to say, the process of the present invention can also be applied to the making of a thicker ceramic fiber blanket with providing substantially the same effects.

The present invention is now described in greater detail by reference to the following examples which are given here for illustrative purposes only and are by no means intended to limit the scope of the invention.

Example

A composition made of 48 wt% alumina, 52 wt% silica and a trace amount of impurities was melted in an electric furnace and converted into staple fibers by blowing. The ceramic fibers were sprayed with a lubricant which was a 0.5 wt % aqueous emulsion of a 1 : 5 (by volume) of aliphatic acid amine acetate (Armac HT ®) and kerosene, and they were then piled on a belt conveyor to form a laminar structure of ceramic fibers. The pile had a density of about 530 g/m^2 (without the lubricant), an average fiber diameter of 2.8 μm and a maximum fiber length of about 250 mm.

Polyester fibers having a fineness of 3 deniers and a length of 76 mm were carded into a web which was punched with 80 needles per square centimeter to give a density of 50 g/m^2. The punched web was unrolled and superimposed on either top or both surfaces of the laminar ceramic fiber pile, and the assembly was punched through the cross section both from above and from below with the number of needles varied as indicated in Table 1. The punched assembly was heated in an oven at 500°C for 30 minutes in the absence of pressure to thereby remove the lubricant and polyester fibers successively. Five ceramic fiber blankets (or sheets) were produced by the above procedure, and the bulk density, weight per unit area and tensile strength of each blanket are listed in Table 1.

Table 1

Polyester web coat	Both surfaces							Top surfaces
Punching density (needles/cm²)	100	100	100	50	100	150	200	150
Thickness (mm)	20.4	12.6	6.3	3.7	3.0	2.4	1.6	2.7
Bulk density	0.16	0.15	0.15	0.12	0.14	0.16	0.18	0.18
Weight per unit area (g/m²)	3,250	1,800	1,000	440	420	380	290	350
Tensile strnegth (kg/cm²)	2.1	1.8	1.6	0.8	1.0	1.5	1.4	0.8

A ceramic fiber blanket was prepared by the method of Japanese Patent Publication No. 43946/77, wherein a laminar pile of ceramic fibes containing a lubricant was punched without laying a web of organic fibers on the pile and was then heated under pressure to remove the lubricant. A maximum tensile strength was obtained when the punching density was about 20 needles per square centimeter, but a product having a bulk density of 0.13 and a thickness of 6 mm had a tensile strength of only 0.35 kg/cm² and a product having a bulk density of 0.16 and a thickness of 20.2 mm had a tensile strength of 0.9 kg/cm².

When the laminar pile of ceramic fibers use in each sample of the Example was punched after treatment with the lubricant but without laying up a web of organic fibers, the pile ruptured at a punching density of 40 needles/cm².

According to the process of the present invention, a ceramic fiber blanket having a great tensile strength that has been unobtainable by the conventional technique is produced, and what is more, a thin blanket that can only be produced by the conventional paper-making method can also be obtained. But as shown in the Example, the punching density should not exceed 200 needles per square centimeter for making a product thinner than about 4mm, since otherwise the tensile strength of the product is lower than that obtained by a punching density of 150 needles/cm² and the ceramic fibers in the blanket begin to deteriorate. If necessary, the web of organic fibers to be laid up on the ceramic fiber pipe may be treated with a lubricant.

The blanket produced by the process of the present invention is usually incinerated as in the Example of remove the organic fibers and used as a product containing of only ceramic fibers. If necessary, only the lubricant may be removed to provide a blanket with a web of organic fibers which may be removed by incineration attendant to the blanket service.

CLAIMS

1. A process for producing a ceramic fiber blanket comprising the steps of preparing a laminar pile of ceramic fibers that comprise 35 to 65% by weight of alumina, 35 to 65% by weight of silica, less than 10% by weight of another metal oxide and a lubricant, superimposing a web of organic fibers on one or both sides of the pile, punching the resulting assembly with barbed needles, and removing the lubricant.

2. A process according to claim 1 wherein the assembly is punched with 50 to 200 barbed needles per square centimeter.

3. A process for producing a ceramic fiber blanket substantially as hereinbefore described.

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